E/CONF.39/A/332
3 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.1

United States of America

MAPS AS A BASIC REQUISITE FOR ECONOMIC DEVELOPMENT

By H. Arnold KARO, Rear Admiral,
Director, U.S. Coast and Geodetic Survey,
Department of Commerce,
Washington, D.C.

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

MAPS AS A BASIC REQUISITE FOR ECONOMIC DEVELOPMENT

by
H. Arnold Karo, Rear Admiral
Director, U. S. Coast and Geodetic Survey
Department of Commerce
Washington, D. C.

1. The universal yearning of man for a better life is marked by insistent demands for more food, adequate housing, an end to illiteracy, improved communications, and the development of all resources both human and natural. "The human race has spent all its yesterday's in a state of chronic and crippling shortages. From harvest to harvest, from hand to mouth--so lived the human family until the 20th century. And so live still perhaps half of the world's peoples." 1/ This is true, not only in so-called less developed nations, but also in those which are highly industrialized.

2. Modern applications of science and technology insure human progress, and serve the needs of the rapidly increasing population in all parts of the world. To meet all challenges, the role played by surveys and maps in benefiting the peoples of every land must be thoroughly understood.

3. Only about one-quarter of the earth's land surface is now adequately mapped. International efforts to solve this problem have been made on various levels through a variety of conferences, seminars, and special agreements between nations without achieving success in meeting the requirements imposed by a rapidly changing world.

4. The United Nations Cartographic Office offers substantial leadership in international cartography. Coordination of cartographic services has been on the agenda of various sessions of the U. S. Economic and Social Council. The United Nations reported in 1949 that it could not "...proceed intelligently in the solution of world problems when adequate information is lacking for three-quarters of the world's land area." 2/ That statement is still true today because mapping the world in detail proceeds so slowly.

5. Dramatic breakthroughs in various scientific fields must not obscure the most basic item essential to economic development and growth--the plain old map. Through maps the earth's surface and subsurface are measured, portrayed, and described, from the smallest local plot to entire nations, and ultimately the globe itself. Both the development of natural resources and industrial expansion are dependent upon detailed maps of proper scale.

1/ Adlai E. Stevenson, The Sunday Star, July 8, 1962. (c) 1962, The North American Newspaper Alliance, Inc.

2/ United Nations, Department of Social Affairs, Modern Cartography, p. 17, (1949).

6. Maps are the medium by which a wide range of vital information on the geography of the earth is conveyed. Basic terrain portrayals do not change materially although mapping is a progressive and constantly evolving science. Information portrayed on maps must be compact to be swiftly comprehended, with symbolization familiar and intelligible.

7. Mapping developed slowly from humble beginnings. In World War I, it achieved renewed significance as some of the principal modern mapping problems became apparent. Since then progress has not stopped.

8. Industrial expansion provided the impetus for mapping in many regions. In this era of less developed nations, the inventory and exploitation of natural resources, the development of national economies, widespread urbanization of extensive areas, more effective utilization of land and agriculatural resources, and many other aspects of man's aspirations toward a better life, are initially predicated on accurate knowledge of the land upon which he lives. Today, mankind's existence depends upon a host of maps and charts vital in planning global economy and security.

9. Because it serves the common good, mapping is recognized as a public service and a function of government. Mapping requires coordination between all levels of government within their respective boundaries. Each nation has a specific duty to undertake and direct the basic mapping of the national domain. Only by progressive programs can a modern, graphic, presentation be provided without which planning degenerates into confusion.

MODERN AGE IN MAPPING

10. Modern maps are used to record and convey information undreamed of by early, orthodox cartographers. It is doubtful, however, if more than a small percentage of the peoples of the world understand or appreciate the value of accurate and detailed maps.

11. Ignorance is the greatest enemy of progress, and maps perhaps are the least understood documents of modern civilization, though widely used. "All ignorance matters, especially ignorance that prevents the earth from realizing its full potential--economic, social, political and aesthetic; and until all nations know exactly what resources of land, water, and air are available to them and on what terms--not to mention knowing how and where their people live and why they die--they are doomed to weakness, inefficiency and needless suffering." 3/

12. During the past decade map and chart production has expanded to undreamed of proportions. The many responsibilities imposed upon national mapping services produced constant improvement in techniques and equipment. Great changes have taken place in all branches of surveying and mapping--from the execution of basic surveys to the final reproduction of sheets on giant multi-colored presses. Stereoplotting and techniques for transferring photogrammetric data into a form suitable for reproduction continue to be improved and made more accurate. Little field surveying is needed for detailed topographic mapping which now is accomplished by aerial photography. Advanced methods of analytical aerotriangulation developed by the U. S. Coast and Geodetic Survey, and similar methods in use by other mapping agencies, require only a minimum of ground control.

3/ The Gap in Maps, Dr. Geo. H. T. Kimble, The Reporter, May 1962.

13. Practical uses of cartographic services on the international stage are of major importance in economic and industrial growth, second only to the development of natural resources.

14. The United Nations Charter in Article 55 states: "With a view to the creation of conditions of stability and well-being which are necessary for peaceful relations among nations based on respect for the principle of equal rights, and self-determination of people, the United Nations shall promote: (a) Higher standards of living, full employment, and conditions of economic and social progress and development:..." 4/ In fulfilling these lofty objectives the United Nations recognized that the science of cartography would play an important role in achieving such aims, and accepted it as an integral part of its operations.

15. The effectiveness of any economic development program is dependent upon the amount and character of basic map information available in both initial and subsequent planning stages. Adequate mapping, in the initial stages of industrial development, saves costly mistakes and assures progress.

16. Maps are the graphic media by which policy can be best prescribed for the development of a country. This is especially true in regional development where nations within a geographic area must collaborate for the maximum benefit of all. Economic, industrial, and natural resources development depend more and more on cartographic services to promote efficiency and economy.

17. In planning economic development, the first mapping required is of a general category to indicate physical geography, including the delineation of such natural features as rivers, coastlines, and relief. Also, a general map will show such cultural features as highways, roads, railroads, bridges, cities, towns, and other details to present an accurate view of the area. Base maps of this category should be on the general scale of 1:100,000 to 1:250,000. Smaller scale maps such as the International Map of the World, scale 1:1,000,000, are often used. This latter map was designated as the base map for integrated development at the First United Nations Regional Cartographic Conference for Asia and the Far East, held at Mussoorie, India, in 1955.

18. All detailed work, after the general planning and orientation stage, depends on the large-scale topographic map, ranging from 1:5,000 to 1:20,000 or even 1:62,500. These maps are used in the location and development of natural resources; in planning and execution of flood control; in irrigation and transportation projects; in selection of industrial locations; and in locating water and sewer systems; new arteries of transportation, or, airports. Very detailed mapping is required for most construction projects with scales as large as 1:500.

19. Many nations have recognized the necessity for detailed mapping programs. Illustrative of this are the cooperative mapping programs, by the United States and other nations, exemplified in a paper to be presented by personnel of the Imperial Ethiopian Government. In Ethiopia the U. S. Coast and Geodetic Survey of the Department of Commerce assisted in a definitive mapping and training program. An extensive network of first-order triangulation and levels was surveyed and permanently marked. This control was for use of the Blue Nile Water Resources Study, and for future surveying and mapping programs. Equally important was the

4/ Article 55, Charter of the United Nations.

trained group of nationals capable of extending this work and other programs which resulted from the initial operation.

MAPPING AND NATURAL RESOURCES

20. The types of resources available to mankind are practically innumerable. To be used effectively they must be inventoried--by mapping--before they can be fully developed and used. Natural resources include minerals; agricultural and forest resources; soils and vegetative cover; water resources; power potential; transportation facilities; and, perhaps, most importantly the human resources of the country.

21. For lack of adequate maps, the identification and exploitation of natural resources for economic development have been retarded by many costly mistakes. An effective resources development program, based on adequate maps, will emphasize and promote sound conservation and use of forest, grazing, and farm lands; water power; and mineral resources. The development and use of lands, minerals, and waters must be coordinated for maximum, sustained economic use.

22. The interrelationship between potentially available resources is best shown and understood on maps. Waterpower, irrigation, and water-transportation are directly related to stream-flow. Other important factors are: the availability of surface, or, groundwater for leaching excessive salts from potentially fertile lands; access to ores, fuel, and power for industrial development and use; and the relationship of potential markets to transportation.

23. The goal of resources development should be to reap maximum benefits on a sustained yield basis from the gifts of nature. This can only be realized by determining the best combinations to meet the long-range regional and national needs for their development and use. Full use of natural resources requires multi-purpose planning and development. In the United States, especially noteworthy are the development of great watershed complexes such as the Tennessee Valley Authority, the Missouri River Basin, Grand Coulee on the Columbia River, and Boulder Dam across the Colorado River. Each stores vast quantities of water and generates billions of kilowatt hours of electricity.

24. Land formations, whether elevated or below sea level, are the key to geologic history of an area. Use of data which gives these facts results in efficient geophysical prospecting. Petroleum reserves are important to the economy of those nations fortunate enough to have such deposits. General purpose maps supplemented by geophysical investigations are standard in land prospecting for oil; for offshore operations, investigations are dependent upon hydrographic surveys, seismic surveys, and other data, all of which must be plotted on maps for proper correlation.

25. Native stands of timber represent the natural wealth of any country. The initial classification of forest resources can be accomplished through proper use of aerial photographic coverage and photo interpretation. With a minimum of field investigation and classification work, key maps can be prepared which will enable accurate photo identification and classification of usable stands of timber. Forests may be divided into such categories as tropical rain, bamboo, palm, broadleaf evergreen, deciduous broad-leaf, coniferous, shrub, and dwarf. In addition to serving as a base for classification, such maps are required to plan and execute a variety of logging operations.

LAND UTILIZATION AND CLASSIFICATION

26. There is a great need for maps to show major categories of land use including: arable land, tree and shrub coverage, vine-planted land; meadows and permanent grassland; market and nursery gardens; woods and forests; non-cultivated agricultural land, and non-agricultural land. Soil surveys, erosion control, land reclamation and soil conservation all require the use of proper maps.

27. A classic example of a long-range soil mapping program is the comprehensive land utilization map of Great Britain which was completed before World War II. This large-scale map series shows in minute detail all the land types of England and Scotland. Great Britain would have suffered immeasurable hardship from lack of food during the war if the soil map had not been available. This map enabled the nation to expand agricultural acreage immediately by 60 percent in the first months of the war, thereby doubling the production of essential foods in the British Isles.

28. On the North American continent exactly the opposite has occurred for lack of maps. The Canadian prairies of southern Alberta and Saskatchewan were settled and the land put to the plow without benefit of maps of any kind. If topographic, water table, precipitation, and climatic maps had been available and used by the early settlers, the fate of vast regions some years later would not have been so disastrous. Poor farming methods got underway in many places. Eventually nature asserts herself. In the drought years of the 1920's, one farm in every three had to be abandoned. The waste, toil, effort, and human suffering which resulted might have been avoided. The "Dust Bowl" in the United States of the 1930's taught an equally harsh lesson.

29. The Food and Agriculture Organization of the United Nations seeks to learn the potential value of land where the production and distribution of food is a problem. In June 1961, a special FAO center known as the World Soil Resources Office was formed. Its objective is the preparation of a soil map of the world at a scale of 1:5,000,000. This project will be conducted jointly by FAO and UNESCO; with FAO responsible for the actual preparation and production of the map, and UNESCO for most of the funds. Soil maps of some areas have already been completed, and exist in one form or other for parts of other areas. Any differences in classification will be considered insofar as possible in compiling a standard soil map. Source material is being collected for soil maps of South America, and a committee has been appointed to supervise the first compilation. This work will be accomplished at the World Soil Resources Office in Rome.

30. Land subdivision should be based on accurate surveys and maps. "Cadastral surveys, in general, create, reestablish, mark, and define boundaries of tracts of land. Such surveys, unlike scientific surveys of an informative character which may be amended with changing conditions or because they are not executed according to the standards now required for accuracy, cannot be ignored, repudiated, altered or corrected, and the boundaries created or reestablished cannot be changed so long as they control rights vested in the lands affected. The official record of a cadastral survey ordinarily consists of a drawing or map and a description of the field work. The drawing represents the lines surveyed, showing the direction and length of each such line; the boundaries, descriptions, and area of the parcel of land; and, as far as practicable, a delineation of the topography of the region, including a representation of the culture and improvements within the limits of the survey." 5/

5/ Pan American Institute of Geography and History's definition of cadastral surveys.

TRANSPORTATION

31. Adequate transportation is essential to any goal of economic growth. The mover is as vital to any economy as the maker or the user. The highway net of a country is a compact image of the very fabric which welds the country into a cohesive entity. Wider use of such new mapping techniques as aerial photography, photogrammetry, electronic computers, and line plotters are solving many tedious routine problems. These new tools and techniques expedite and refine area mapping important in establishing and developing a sound transportation system.

OCEANOGRAPHY AND CHARTING

32. Oceanography offers an especially challenging opportunity for improving the economy of the world. Each nation with a coastline has undisputed title to a vast limitless treasure of power, mineral, and food resources. Recognition of the potential wealth of the oceans has come late in our economic culture. It is foolish to design detailed techniques for harvesting any resource without first identifying and determining its distribution. Maps are the first step in reaping this boundless harvest. In the transition from an agrarian to an industrial economy, the oceans have been largely overlooked because the majority of the earth's inhabitants neither understand nor appreciate their vast potential benefits. All oceanic areas may be said to be "less developed" with respect to their optimal utilization.

33. Specific objectives to be considered are the development of food resources; the development of physical resources such as mineral and power; and the conservation and protection of the shoreline and coastal installations. In exploiting food resources, knowledge must be developed on the distribution of nutrients, primary productivity, and ultimate harvest; for physical resources, a knowledge of the physical properties of coastal waters is essential. But basic to all endeavors involving the sea is a knowledge of its hazards. Studies, and detailed mapping and charting are essential for protection against tsunamis, floods, and storm damage to the shoreline and to coastal structures; even the open ocean must be guarded against the effects of industrial and human pollution.

34. Those few nations which have been forced to turn to the sea have been amply repaid. The success of the Japanese in extracting proteins and fats from the sea is well known. Growth of knowledge about the true nature of the oceans will result in increased confidence in ability to utilize marine resources to their fullest measure. Toward this end comprehensive mapping both in submarine topography and of the various geophysical parameters of the oceans must be undertaken. A more complete understanding of the 71 percent of our globe which comprise the oceans will add immeasurably to our ability to meet the economic problems of the future. Many of our less developed nations will have increasing opportunities to use this new knowledge in recovering an ever-increasing amount of food and other resources from the sea.

MODERN TECHNOLOGY IN MAPPING

35. The magic word in modern surveying and mapping is electronics. New techniques now in use are particularly applicable in the field of geodesy where the first requisite in mapping an area is to fix the locality precisely in its relation to the surface of the earth.

36. Through leadership provided by the International Association of Geodesy, and collaborators in various countries, important strides are being made in coordinating the triangulation systems of continental areas. Artificial earth satellites will afford new methods of refining the dimensions of the earth, and provide a world-wide geodetic network. Satellite triangulation will be particularly effective in tying together continental datums. The U. S. Coast and Geodetic Survey has perfected a system of satellite geodesy in which either active or passive satellites can be used

effectively Successful observations from about 120 stations strategically placed in the existing geodetic nets of the world, and in areas where none presently exist, would give a strong world-wide geodetic datum.

37. Refinements in the science of measurement are playing an important role in modern surveying and mapping. Newly developed instruments utilizing electromagnetic and light waves are used for distance measurements requiring a high degree of accuracy. These instruments are now being used to extend an ultra-precise traverse across the United States which will tie together the continental triangulation, and also furnish a base-line of extreme accuracy for use in satellite geodesy.

38. Aerial photography is now the most widely used method of compiling map detail and contours in topographic mapping. Analytical aerial triangulation is used more and more to furnish additional control. With precision wide-angle lens cameras, photogrammetric mapping is an unexcelled method of compiling the map detail needed for economic development and growth.

39. In addition to the use of modern techniques in map production, international standards of accuracy, symbolization, scale, and treatment of detail must be achieved. Acceleration in research and development will provide new instruments and techniques for increased accuracy, production and economy.

40. Proper attention to the detailed specifications for field work and compilation can insure that the original basic mapping will provide for the production of maps of varying scales and composition to meet most foreseeable needs without the necessity of additional field work, or at most, a minimal amount of work. Present instrumentation and methods permit highly accurate original work with little or no additional expense except in the types of equipment used, which is minor compared to operational costs. Precise geodetic control surveys can be accomplished, and accurate aerial photography obtained by using the instruments now available. From this basic survey data, maps of varying scale, detail, and accuracy can be compiled to meet the needs of a developing economy. These may vary from the simple photo, topographic, geologic, soil, or transportation map to the very large-scale construction type. Proper attention to original specifications will expedite the economic development of an area, and at the same time result in a more economical and efficient product. The value of a properly controlled base map cannot be overestimated.

CONCLUSIONS AND RECOMMENDATIONS

41. Good maps based on precise geodetic control surveys are essential to the economic development of any area, region, or state. It is impossible to efficiently plan the development of any area without an inventory of the natural and human resources, showing locations, limitations, and other environmental influences affecting their development; also, what transportation and communication facilities exist and what can be economically provided. Whatever type of planning is undertaken, there must be maps upon which to do the basic work. Adequate mapping in the initial stages saves costly mistakes and expedites progress in any economic development program. Without good maps, planning degenerates into confusion and frustration.

42. It is recommended and urged that:

(a) Adequate surveys and maps be placed high on the priority list of any economic development program.

(b) That specifications for surveys and maps consider current instrument development and prescribe that precision surveys and aerial mapping be made with cameras and lens capable of providing quality photographs from which accurate, detailed maps of various scales and content can be prepared.

(c) That airborne magnetometer, scintilometer, and other geophysical instruments be used in conjunction with the aerial mapping to obtain at the same time a geophysical profile of the area under development.

1573 E - Nov.1962 - 1,600